The Efficiency of Using Vermicompost and Some Bio-Safe Stimulants in Recovering Yield and Quality of Flame Seedless cv. in Degraded Vineyard

Yasmin A. Elsayed[*] and Y. M.E. El-Shewaikh[**]

[*]Central Laboratory of Organic Agriculture, Agricultural Research Centre, Giza, Egypt.
[**]Ornamental Plants and Landscape Gardening Researches Department, Horticulture Researches Institute, Agricultural Research Center, Giza, Egypt.

ABSTRACT

Improving viticulture ecosystems sustainability over the application of organic fertilizers with various bio-safe stimulants is the main objective of this work to obtain high yield and quality with high income. Therefore, this trial was conducted in 2020 and 2021 after a preliminary season 2019 to highlight the role of the organic fertilizer Vermicompost (VC) associated with two types of biostimulants namely Arbuscular Mycorrhizal Fungi (AMF) at 150 & 300 g/vine, and three Plant Growth Promoting Rhizobacterial (PGPR) strains at 50% &100%, or the natural fertilizer Potasssium Humate Gel (PHG) at 50 &100 %. All combinations were applied in the presence of 50% of the vineyard basic mineral fertilization on seven years-old Flame Seedless cv. grapevines planted in a sandy loamy soil in a private degraded vineyard located at 58 km Cairo- Alexandria desert road, Egypt. Moreover, all the treated vines were sprayed twice with VC extract at two phonological stages, when cluster length about 10-15 cm and when berry diameter reached about 7-8 mm for boosting vegetative growth, nutritional status, yield and fruit quality. The obtained results indicated that VC associated with various stimulators half doses 50% or fully ones 100% had an affirmative role in improving all the parameters over the control vines. The clear superiority of these responses were scored by mixing VC soil application with PGPR 100% which was more favorable in stimulating growth parameters, physical and chemical characteristics of berries, yield and nutritional status. However, the co-application of VC plus 100% PHG had distinctive effect on total leaf chlorophyll content (SPAD). Thus, there is a wide range of organic and biostimulants products which considered as a valuable choice to be investigated for decreasing the harmful impact of synthetic fertilizers with high inputs for providing food security and matching the overpopulation.

Keywords: Vermicompost, Plant Growth Promoting Rhizobacterial (PGPR), Potassium Humate, Arbuscular Mycorrhizal Fungi (AMF), Flame Seedless quality.

INTRODUCTION

In Egypt, Grape *(Vitis vinifera* L.) is one of the valuablefruit crops which occupies the second position following citrus in terms of production with a total harvested area reached about 85240 ha and total production approximately 1.6 million ton (FAO state, 2021).

The Red table grape "Flame seedless" is a hybrid of Thompson Seedless, Cardinal and other cultivars, it produced in Fresno, California by the U. S. Dept. of Agriculture released in 1973, it considered the most favorable verity and widely planted in Egyptian vineyards, early-season cultivar characterized as sweet, firm and crispy berries with large to medium clusters and moderate vigorous vines. (Brooks and Olmo, 1997).

In the recent years, consumers in the local and global markets are seeking for organic horticultural crops, safety and

healthy food with high quality besides reducing the intensive use and the harmful impact of mineral fertilizers by maximizing the applications of eco-friendly approach.

In viticulture, the decrease in soil organic matter content in degraded vineyards will negatively influence soil fertility and reduce all its properties which have in turn a negative effect on yield and quality of grapevines **(**Mondini et al., 2018**).** So sustainable agriculture practices could be a useful factor to maintain soil quality and increasing crop productivity particularly under organic agriculture systems which have several advantages for environment and human health **(**Scotti et al., 2015).

Among all the sustainable tools, Vermicompost (VC) has received more attention recently, it considered as a natural product produced by the interaction of earthworms and plant wastes (Blouin et al., 2019), represent as a source of organic material as well as rich in macro and micro nutrients, plant growth regulators, beneficial microorganisms like bacteria, fungi, actinomycetes, antibiotics ,phytohormones , N fixing and P-solubilizing bacteria (Yatoo et al., 2020). Also, it has several benefits due to the positive impact on improving soil fertility and structure, growth and productivity of horticultural crops and more effective in biological resistance against plant diseases (Joshi et al., 2015; Zhu et al., 2017 and Yatoo et al., 2021).

Recently, it should be mentioned that the response of vermicompost in releasing plant nutrients is strongly influenced by soil characteristic and the easily available of nutrients forms, which are slowly released over the time. (Hoque et al., 2022).

Additionally, Potassium Humate Gel (PHG) is active natural fertilizer which have indirect effects such as it can be used for improving soil physical and biochemical properties through increasing the microbial numbers and ion exchange. It is play a major role in enhancing the photosynthesis ,protein synthesis, enzyme and hormonal activities like auxin, cytokinin and gibberellins Idrees et al., (2018), Humic substance had the efficiency of increasing water and nutrient uptake rate by the activity of the fixed potassium in the soil. As well as, the easily absorption by roots and prevent it from losing which positively boosts plant growth and productivity as a clear direct impact (Jindo et al., 2020 and Mahdi et al., 2021).

Further, plant biostimulants compounds become the main concern for grape production in organic and conventional vineyards to achieve sustainability.

In this respect, Arbuscular Mycorrhizal Fungi (AMF) are a microorganisms play an important role for the uptake of several vitamins and micronutrients, represents various advantages for grapevines productivity and quality through the symbiotic association between the fungal hyphae and the vine's roots Nogales et al ., (2019).The inoculation of vineyard soil with AMF could be enhance the water use efficiency, soil structure in addition to providing phosphorus absorption and other nutrients uptake ,thus will led to decreasing the utilizing for inorganic fertilizers for natural eco-system.(Anli et al., 2020 and Cataldo et al., 2022).

One of the remarkable strategies is the multifunctional inoculants (PGPRs) Plant Growth Promoting Rhizobacteria which includes various microorganisms du Jardin, (2015). These ideal inoculants had a direct and indirect effects on enhancing vineyard soil degradation, the availability of N-fixing, P-solubilizing , releasing potassium bacteria and Phytohormone production, hence will influence plant nutrient uptake finally reflected in promoting plant growth and crop productivity (Rolli et al., 2017 and Oleńska et al., 2020), in addition to vines tolerance to biotic and abiotic stresses as safe alternative sources for the synthetic fertilizers overdoses

in viticulture Cataldo et al., (2022). In a trial by Lu et al., (2020) recorded that the application of biofertilizers (PGPR) inoculant improved growth and quality of Red Globe grape cv. besides the positive effects on soil microbial community.

Also, Vermicompost extract is the liquid form of vermi-products have high potential in enhancing growth , yield and suppress different diseases which attributed to its content of various nutrients ,plant growth promoters and microbes (Arancon et al., 2020).

Increasing organic production has become a necessity. Therefore**,** the key objective of this research is to provide insight into the potential role of vermicompost with various biostimulants as environmentally bio-safe for boosting vegetative growth, nutritional status, yield and fruit quality attributes of Flame seedless grapevines in degraded soil to ensure sustain food security.

MATERIALS AND METHODS

This study was performed through two successive seasons (2020 & 2021) with previous preliminary season 2019 on seven years-old Flame seedless cv. grapevines planted in a conventional private vineyard (not registered as organic vineyards) located at 58 km Cairo - Alexandria desert road, Egypt. Grown in a sandy loamy soil under drip irrigation system, trellised by Spanish Parron trellis system with space 2 X 3 m apart. All the vines were spur-pruned at the first week of January with a total bud load of 60 buds/vine (30 fruiting spurs x 2 buds/ spur). Sixty- three uniform vines were carefully chosen for this experiment which designed as 7 treatments x 3 replicates x 3 vines/replicate.

The vineyard conditions and some agricultural practices used to improve soil content and yield:

The vineyard was exposed to irregular agricultural managements represented as poor fertilization and irrigation, lack of soil nutrients components, as shown in Table 1, which negatively affected the productivity. So, it was imperative to use organic and soil biostimulants applications regularly to raise soil efficiency and improve yield quality beside the common vineyard practices.

The applied treatments were as follow:

1- Control (50% Mineral Fertilization (MN) according to the vineyard program).
2- 50%MN + Vermicompost (VC) + Arbuscular Mycorrhizal Fungi (AMF) 50%.
3- 50% MN + VC+ (AMF) 100%.
4- 50% MN + VC + Potasssium Humate Gel (PHG) 50% (5L/feddan).
5- 50% MN + VC+ (PHG) 100% (10 L/ feddan).
6- 50% MN + VC+ Plant Growth Promoting Rhizobacterial (PGPR) 50% (5L/feddan).
7- 50% MN + VC+ (PGPR) 100% (10 L/feddan).

Materials source, doses and timing of applications:

- Vermicompost (VC) used as a source of organic matter were obtained from Central Laboratory of Organic Agriculture, (CLOA) Agricultural Research Center (ARC), Giza, Egypt, it was added as soil application once at winter (the second week of January after pruning) in the three seasons, the selected vines received 6.12 kg/vine dose (30 cm soil depth). Major components analyses are presented in Table (2).
- Potasssium Humate (PHG) was prepared in gel formula by (CLOA), (ARC), Giza, Egypt. The gel form used is 10% carboxymethyl cellulose was added to the concentrated solutions.
- The spores of Arbuscular Mycorrhizal Fungi (AMF) (40-50 g/inoculum mixed with sand as a carrier) were obtained

from Soil, Water and Environment Research Institute, Agricultural Research Center (ARC), Giza, Egypt. It was added with two rates as 150 and 300g/vine at winter.

- Three Plant Growth Promoting Rhizobacterial (PGPR) strains, i.e., nitrogen-fixing bacteria (*Azotobacter chrocoocum*), Phosphate dissolving bacetria (*Bacillus megaterium* Var. *Phosphaticum*), and potassium releasing bacteria (*Bacillus circulans*) were provided by (CLOA), (ARC), Giza, Egypt. The different bacterial treatments were prepared as liquid culture by using Nutrient Broth (NB) as a growth medium and were adjusted to contain 10^8 CFU/ml (Abdelrahman et al., 2021).
- The organic fertilizer (PHG) and the biostimulant (PGPR) were added as soil addition in liquid status as 2L/vine from each concentration once at winter.

Further, beside the common vineyard practices the following additional foliar application was used:

All the adopted vines (except for the control) were sprayed twice with vermicompost extract at two phonological stages, when cluster length about 10-15 cm and the second when berry diameter reached about 7-8 mm, using a hand pressure sprayer till run off.

Vermicompost extraction method:

It was prepared by soaking 1 kg of vermicompost with 5 L/water (free from chlorine) with the addition of 25 gm. of molasses to promote the microbial growth activity during the preparation. In addition, the mixture was stirred 3 times/day to encourage aeration and fermentation for seven days. This mixture was filtered well and diluted to a rate of (1 L/ vermicompost extract: 10L/water). Then it was refrigerated until using. The chemical analysis is shown in Table (3).

Table (1): Chemical and physical characteristics of the experimental soil:-

Mechanical analysis		**Concentration of available macro and micro elements (mg/ kg soil)**	
Sand (%)	70.8	N	80.2
Silt (%)	2.6	P	28.6
Clay (%)	26.6	K^+	3.52
Texture grade	Sandy loam	Ca^{++}	2.07
Chemical analysis		Mg^{++}	2.43
pH(1:2.5 extract)	7.75	Fe	5.11
EC ($ds.m^2$)	1.20	Zn	4.23
Organic carbon (%)	0.08	Mn	3.90
CO_3^{--}	-	Cu	1.89
HCO^-	1.45	Na^+	4.3
SO_4^{--}	5.39	Cl-	5.14
No. nematodes (larva/ 200 g soil) 620			

Table (2): Physical and chemical components analysis of Vermicompost material

Analysis	Value
M^3 weight (kg)	720
Moisture content (%)	18
pH (1:10)	8.6
EC (1:10) (dS/m^2)	5.25
Total nitrogen %	1.65
Total phosphor %	0.90
Total potassium %	2.41
NH^{3+} (ppm)	390
NO^{3-} (ppm)	122
Organic matter O.M (%)	30.26
Organic carbon O.C (%)	16.51
Ash (%)	68.65
C/N ratio	12:1

Table (3): Chemical and physical components analysis of Vermicompost extract.

Content	Values
pH	6.55
EC (ds/m^2)	2.81
Organic Matter %	5.97
Organic Carbon %	3.11
C/N Ratio	6:1
Total N %	1.50
Available P_2O_5	1.12
Available K_2O	0.93
Fe mg/L	13.10
Zn mg/L	7.14
Mn mg/L	3.00
Cu mg/L	1.26

Different characteristics were assessed as follow:

1- Vegetative growth characteristics

- Average shoot length (cm): calculated as average of 4 fruitful shoots/ vine.
- Average leaf area (cm^2) of the apical 5th and 6th using leaf area meter, Model CI 203, U.S.A.) at harvest.
- Wood Ripening (%): at growth cessation the coefficient of wood ripening was calculated according to Bouard, (1996) using the following equation:

Wood ripening % = the length of ripened part per shoot / Total shoot length x100.

2- Yield and berry quality:

2.1. Physical analysis:

-Yield (kg / vine) was estimated.

-Average cluster weight (g) cluster length and width (cm) were calculated.

-Average Berry diameter, length (cm) and volume (cm^3) were determined.

2.2. Chemical analysis:

At ripening stage 12 clusters/ treatment were harvested randomly when berry TSS reached about 16-17 % with a full red color according to **(**Tourkey et al., 1995) for the following assessment:

-Total soluble solids TSS (%) in berries by using handy refractometer.

-Acidity (%): as g tartaric acid/ 100 ml juice was measured according to A.O.A.C. (2000).
-TSS /acid ratio was calculated.
-Total sugars (%) were determined according to Sadasivam and Manickam (1996).
-Anthocyanin content (mg/100g F.w) was determined in berry skin using spectrocolourimeter at 250 µm according to Yilidz and Dikmen (1990).

3- Leaf chemical analysis:

At full bloom fresh leaves were collected from the opposite to the clusters for the following determinations:

-Total chlorophyll content (SPAD): using the nondestructive Minolta chlorophyll meter model SPAD 502. **(**Castelli et al., 2008).

- Macro nutrients content in leaf petiole: Nitrogen (%) as described by Bremner and Mulvaney (1982), phosphorus (%) by Temminghoff and Houba (2004) and potassium (%) according to Balo et al., (1988).

4- Statistical analysis

The randomized complete block design was adopted for the present experiment according to (Mead et al., 1993) using the new L.S.D. values at 5 % level.

RESULTS AND DISCUSSIONS

1-Impact of vermicompost with bio-stimulants or potassium humate treatments with different doses on yield and cluster physical characteristics:

- Yield (kg), cluster weight (g) and dimensions (cm).

It is evident from Table 4 that yield/vine, cluster weight as well as cluster length and width were clearly statistically affected in response to vermicompost, potassium humate and different bio-stimulants with more doses in both seasons. The maximum yield and the best clusters width and weight values were correlated with 50% MN + VC addition in presence of PGPR at 100% in both seasons compared with the control vines, which attained the lowest values in this respect, except for those which treated by 50% MN + VC+ Potassium humate gel (PHG) in full dose at 100% recorded the longest cluster length in the 1st season only as compared with all conducted treatments. Moreover, insignificant differences were found between both treatments 50% MN + VC+ PGPR at 50% and 50% MN + VC+PHG at 100% concerning yield /vine, cluster weight and length in both seasons.

The previous increase in yield and it's characteristics could be explained by Am-Euras (2009) who proved that all composts types could only provide N about one half effective as compared to chemical fertilizer, whereas P & K are effective as chemical fertilizers. So, these types could act as 'a slow-release fertilizer' while the chemical fertilizers released their nutrients more quickly then get depleted. In addition, N and P are not available to the plant roots in the first year. Therefore, the continuous application of these types will enhance the organic nitrogen to be released with a stable rate from the accumulated 'humus' and get the overall efficiency of nitrogen on the long run. Hence, the availability will be greater than 50% of those from chemical fertilizers.

The previous findings are in harmony with those mentioned by (Mokade, 2015; Mosa et al., 2016; Hassan and Salem, 2020 and Pawar et al., 2020) on apple trees, Flame Seedless grapevines and orange trees. They reported that the soil application of vermicompost is considered one of the effective methods to rejuvenate the depleted soil fertility, maintaining soil quality and the

availably of nutrients which could be related to improving fruit weight and yield.

Similarly, The beneficial effects of these organic and biofertilizers in enhancing the extraction of soil hormones and cytokinins production , root development, nutrients solubility and soil workability were the best treatments for improving yield of Thompson Seedless grapevines El-Mahdy et al., (2017).

Also, increasing the soil posture will be reflected on increasing yield and productivity of different grape varieties which was confirmed by (Yeole, 2021; Abd El- Rahman and Bakr, 2022). Besides, the mix of foliar application and soil addition with both PGPR and vermicompost tea had a great impact on yield and fruit weight of Manfalouty pomegranate cv. (Abdel-Salam et al., 2022).

Table (4): yield and cluster physical characteristics of Flame Seedless cv. as affected by vermicompost with biostimulants or potassium humate with different doses in 2020& 2021 seasons.

Treatments	Yield/vine (kg)		Cluster weight (g)		Cluster length (cm)		Cluster width (cm)	
	2020	2021	2020	2021	2020	2021	2020	2021
1-Control (50%MN)	7.84	8.32	392.00	409.69	10.96	11.73	6.48	7.56
2-50%MN+VC+AMF50%	10.63	11.40	473.64	492.91	17.96	20.86	11.00	13.03
3-50%MN+VC+AMF100%	11.62	12.76	505.49	529.28	18.93	21.30	12.80	13.93
4-50%MN+VC+ PHG 50%	11.71	13.70	488.32	548.35	20.73	21.60	11.60	14.03
5-50%MN+VC+PHG 100%	14.51	16.42	580.57	640.00	20.93	21.63	13.06	14.26
6-50%MN+VC+PGPR 50%	14.44	15.88	573.19	610.81	19.76	21.53	11.23	11.60
7-50%MN+VC+PGPR 100%	16.02	18.10	615.22	646.63	19.96	22.16	13.96	14.53
New L.S.D at 0.05	0.84	0.93	44.78	41.83	2.30	2.10	0.95	0.89

-Average berry diameter, length (cm) and volume (cm^3):

The joint application of vermicompost as soil additions with various conducted biostimulants treatments or potassium humate in presence of 50 % mineral fertilization significantly affected all berry physical parameters which recommended in the markets. Data in Table 5 present that the superiority was found in 50% MN + VC with the high rates of the biostimulant PGPR at 100% dose. Which it significantly increased the average berry diameter, length and largest berry volume in both 2020 and 2021 seasons. While using 50% MN + VC plus PHG at 100% occupies the second rank in this respect as compared with the control treatment. In addition, there is insignificant differences observed in the previous readings between 50% MN + VC+AMF 100% and 50% MN + VC+ PHG 50% in both seasons.

These results are in a parallel with Tangolar et al., (2019) on Yalovaincisi grape cv. Sharifi and wambold, (2019) on Chardonnay grapevines. Also, Hassan and Salem (2020) refers to the best management system for Flame Seedless grapevines is the use of organic fertilizers with N fixing bacteria which enhanced berry weight and size in comparison with the control vines.

Table (5): Berries physical characteristics of Flame Seedless cv. as affected by vermicompostwith bio-stimulants or potassium humate treatments with different doses in 2020& 2021 seasons.

Treatments	Berry diameter (cm)		Berry length (cm)		Berry volume (cm^3)	
	2020	2021	2020	2021	2020	2021
1- Control (50%MN)	1.39	1.41	1.29	1.32	2.12	2.15
2- 50%MN+VC+AMF50%	1.55	1.57	1.46	1.40	2.13	2.22
3- 50%MN+VC+AMF100%	1.63	1.67	1.50	1.52	2.28	2.33
4- 50%MN+VC+ PHG 50%	1.62	1.67	1.50	1.53	2.22	2.42
5- 50%MN+VC+PHG 100%	1.72	1.77	1.56	1.64	2.64	2.84
6- 50%MN+VC+PGPR50%	1.68	1.71	1.50	1.61	2.43	2.58
7-50%MN+VC+PGPR100%	1.75	1.84	1.63	1.70	2.88	2.97
New L.S.D at 0.05	0.05	0.06	0.08	0.07	0.07	0.09

2- Impact of vermicompost with bio-stimulants or potassium humate treatments with different doses on cluster chemical characteristics and quality.

Significant effects between all applied treatments were observed in total soluble solids TSS (%), Acidity (%), TSS /Acid ratio, Total sugars (%) and Anthocyanin content (mg/100g F.w) were registered by the applications of 50% MN with both forms of organic and biostimulants with different doses when compared with the control as clearly displayed in Table 6. The addition of 50% MN + VC with the highest dose of PGPR at 100% rate caused in enhancement of the important quality parameters of table grapes in terms of TSS %,TSS /Acid ratio, Total sugars (%) and the highest berry skin content of anthocyanin in both successful seasons. While, 50% MN + VC+ PHG with full dose comes in the second position. Also, it is noticeable that both 50% MN + VC+ AMF with the two different doses 50 % and 100 % were statistically equal in TSS%, total sugars and Anthocyanin content in both seasons. Oppositely, the mineral fertilized vines (control) showed the lowest percentages and values in the two seasons.

The increase in chemical parameters of berries are ascribed to the use of organic fertilizers with N fixing bacteria which maintaining a good balance between total carbohydrates and nitrogen, that will lead to increasing yield and improving berry quality, which is considered the best management system for Flame Seedless grapevines Hassan and Salem (2020). In the same line results by Yeole (2021) on both Thompson seedless and Sharad black cvs.

The improving of the chemical characteristics in Thompson Seedless grape clusters were due to the strong relationship between fertilization and increasing soil nutrients which were positively linked to providing energy for soil microbial activity and alters microbial communities while the opposite was found in the control treatment. Zhu et al., (2022).Also, Abd El- Rahman and Bakr (2022) have the same results on Superior seedless grape cv.

On contrary, a decline trend in juice acidity as considered a key quality characteristic was observed in Table 6. The control treatment as chemical fertilization gave the highest juice acidity % whereas vines received the combination of 50% MN + VC as organic fertilizer and 100% PGPR as biostimulants had a pronounced effect in recording the lowest juice acidity % in both seasons. Followed by the fifth treatment of 50% MN + VC + PHG at 100 % in both seasons of the study.

The obtained data are in agreement with (Hassan and Salem 2020; Dheware et al., 2020;Yeole 2021 and Abdel-Salam et al., 2022). On different grape varieties and fruit crops.

Table (6): Berries chemical characteristics of Flame Seedless cv. as affected by vermicompost with biostimulants or potassium humate treatments with different doses in 2020&2021 seasons.

Treatments	TSS (%)		Acidity (%)		TSS /acid ratio		Total sugars (%)		Anthocyanin content (mg/100g F.w)	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
1-Control (50%MN)	14.29	14.31	0.611	0.614	23.25	23.29	13.21	13.28	20.18	20.27
2-50%MN+VC+AMF50%	15.23	15.40	0.520	0.491	29.12	32.51	13.88	14.03	23.05	23.55
3-50%MN+VC+AMF100%	15.43	16.03	0.473	0.460	32.62	35.23	14.18	14.25	24.13	24.80
4-50%MN+VC+PHG 50%	15.60	16.73	0.463	0.445	33.69	37.62	14.47	14.51	25.51	26.63
5-50%MN+VC+PHG 100%	17.16	18.40	0.441	0.436	38.89	42.16	15.26	15.39	29.66	29.84
6-50%MN+VC+PGPR50%	16.20	16.93	0.449	0.440	36.07	38.45	14.61	14.73	27.12	28.48
7-50%MN+VC+PGPR100%	18.40	18.96	0.432	0.425	42.64	44.69	15.79	16.00	30.46	30.84
New L.S.D at 0.05	0.95	0.85	0.017	0.015	2.77	2.28	0.61	0.79	1.70	1.50

3-Impact of vermicompost with bio-stimulants or potassium humate treatments with different doses on vegetative growth parameters and Total chlorophyll content (SPAD).

The positive action of applying 50% MN plus vermicompost, as well as the biostimulants or potassium humate with different doses was recorded to assess average shoot length (cm), leaf area (cm²) and wood ripening % as in Table 7. The vegetative growth parameters were positively stimulated by using the combined treatment of 50% MN + VC+ PGPR 100% which proved a significant differences and gave the highest shoot length, the largest leaf area and highest percentage of wood ripening as a remarkable characteristics affecting yield on Flame seedless grapevines in both considered seasons. Whereas, the remaining treatments including the control (50% Mineral fertilization) one recorded the least values.

Stimulating overall plant growth in "Italy" and Flame seedless grapevines by the applications of organic fertilizer with triple or single inoculation of (PGPR) were confirmed by (Erdogan et al., 2018 and Hassan and Salem, 2020).

Similar results were obtained by (El-Salhy et al., 2017 and Abd El- Rahman and Bakr, 2022) they reported that the effectiveness of using both organic and biofertilizers in enhancement of vegetative growth parameters of Thompson seedless and Superior Seedless grapevines were attributed to the improving of nutrients uptake and translocation, So it will increase carbohydrate and protein synthesis, encourage cell division as well as induces resistance of plant to root diseases and increasing the production of natural hormones and cytokinins, which in turn improve root development and increasing grapevine growth, hence improving vine quality and productivity.

-Total chlorophyll content (SPAD).

Results in Table 7 revealed that leaf pigment content was significantly improved by 50% MN with the double application of organic and all biostimulants treatments applied with various concentrations. Generally, the highest leaf chlorophyll content was detected in leaves from vines

fertilized by 50% MN + the two applications of VC with 100% of Potasssium Humate gel (PHG) in the both seasons of study. Also, 50% MN + VC+ the high doses of PGPR comes in the second order. While, the treatments 50% MN + VC + PGPR with both doses 50 % or 100 % and 50% MN + VC+ PHG 50 % were statistically similar in the 1st season only. Meanwhile, the control vines received 50% mineral fertilization appeared to be the lowest content in this regard.

The above mentioned results are in harmony with (Mohamadineia et al., 2015 and Birjely and Al- Atrushy, 2017).

The improving in chlorophyll content are probably suggested to the action of potassium humate in promoting photosynthesis, cell respiration, protein synthesis and carbohydrates transportation, which cause an increment in the synthesis of the chlorophyll or delayed chlorophyll degradation on Flame Seedless grapevines. (Doaa and Raeesa, 2020 and Abd EL-Rahman et al., 2021).

Table (7): Vegetative growth parameters and total chlorophyll content (SPAD) of Flame Seedless cv. as affected by vermicompost with biostimulants or potassium humate treatments with different doses in 2020& 2021 seasons.

Treatments	Shoot length (cm)		leaf area (cm^2)		Wood ripening (%)		Chlorophyll (SPAD)	
	2020	2021	2020	2021	2020	2021	2020	2021
1-Control (50% MN)	134.4	135.6	136.33	137.90	64.40	64.78	30.50	31.16
2-50%MN+VC+AMF50%	150.1	152.9	153.65	156.49	81.09	82.48	33.70	33.83
3-50%MN+ VC+AMF100%	161.1	165.66	158.33	161.34	83.91	85.73	33.90	34.66
4- 50% MN + VC+ PHG 50%	170.9	174.7	165.23	166.95	85.79	87.11	34.53	35.60
5-50% MN+ VC+PHG 100%	178.0	181.4	170.66	172.01	87.07	89.51	35.96	37.70
6-50%MN+ VC+PGPR50%	184.9	186.6	172.25	174.20	90.50	91.28	34.86	35.30
7-50%MN+ VC+PGPR100%	191.6	196.5	174.03	177.13	91.84	92.69	35.06	36.13
New L.S.D at 0.05	1.58	1.89	1.63	1.35	1.15	1.24	0.6	0.4

4- Effect of vermicompost with bio-stimulants or potassium humate treatments with different doses on macro nutrients content in leaf petioles.

It's clear from the obtained data presented in figure 1 that all performed treatments have a great impact on leaf petioles of N %, P% and K% content. The application of the sixth treatment 50% MN + VC + PGPR 100% scored statistically the highest percentage of leaf mineral content followed by the fourth treatment 50% MN + VC + PHG 100%, whereas, mineral fertilization treatment (control) came in the last order. Also, the other treatments were in between during the two seasons of the work.

Apparently from the previous readings, the continuous application over years of all composts types as "slow-release fertilizer" will improve the releasing rate of organic nitrogen from the accumulated humus by 50% instead of providing half-quantity of nitrogen in the first year as compared to chemical fertilization (Am-Euras,2009).

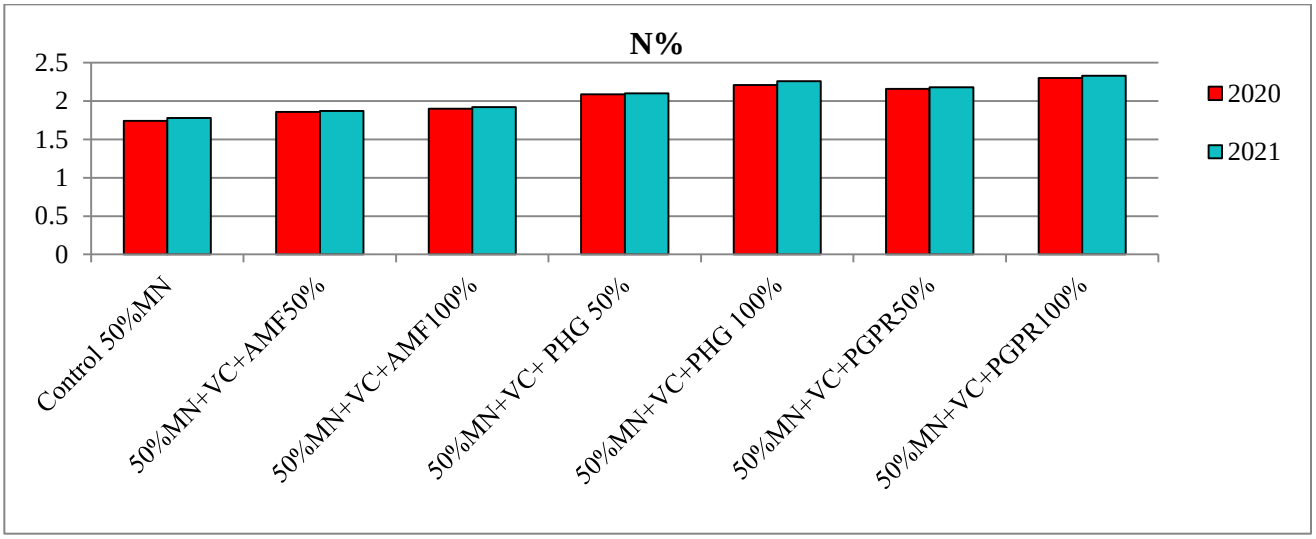
The great influence of PGPR is represented by facilitating the uptake of nutrients from the soil through different mechanisms such as biological nitrogen fixation, solubilization of inorganic phosphate, enhancing plant uptake of immobile nutrients which make it more available for the plant. Also, promoting the growth of phosphate solubilizing microorganisms around roots. Once it released the plant could had the full potential. So, it will in turn to a positive

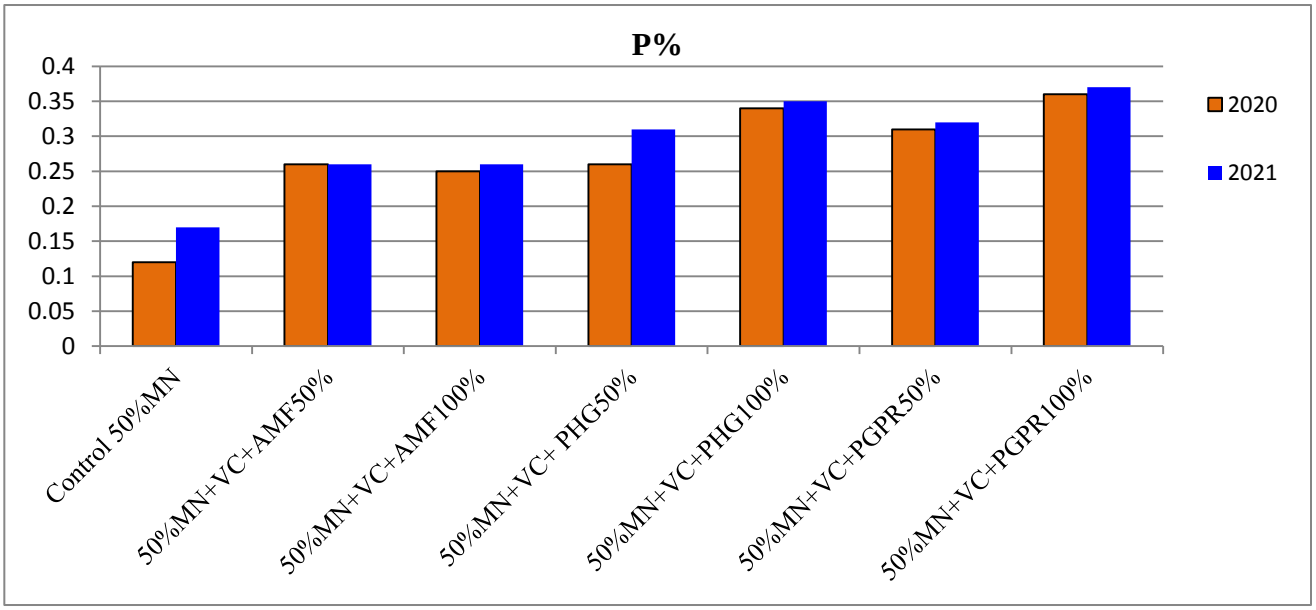
increase in macro nutrients in leaf petioles, growth and yield. Erdogan et al., (2018).

On Thompson Seedless and Superior seedless grapevines (EL-Mahdy et al., 2017; El-Salhy et al., 2017 and El- Rahman and Bakr, 2022) they explained the positive action of (50% inorganic + 50% organic + biofertlizer) in increasing leaf petioles nutrients content were mainly due in enhancing soil organic matter, microbial activity, soil aggregation and aeration, soil permeability, photosynthesis process, fixation of N, root development, nutrient availability and transportation.

On Besides, vermicompost is considered a promising supplementary treatment, having a similar effect in enhancing the leaf petioles nutrient content through increasing soil quality and decreasing nutrient leaching of Sauvignon Blanc and Alphonse lavallée varieties (Martinez et al., 2018 and Koç et al., 2021).

On the other hand, the influence of these PGPR based on several factors as environmental conditions, soil characteristics, and crop species (Pacifico et al., 2019).





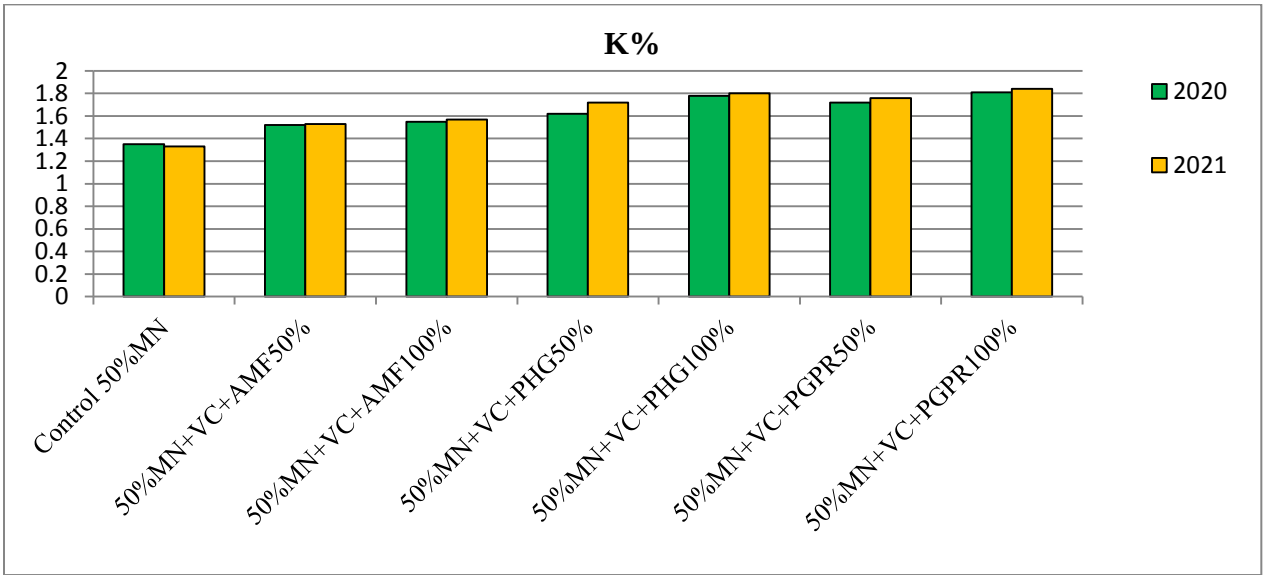


Figure 1: Macro nutrients content in leaf petioles of Flame Seedless cv. as affected by vermicompost with biostimulants or potassium humate treatments with different doses in 2020& 2021 seasons.

CONCLUSION

In conclusion, the results showed that using 50% MN + Vermicompost as organic fertilizer with all the combined applications with different rates 50% or 100% had a positive effects in increasing all the parameters with a clear preference for mixing the two soil applications of Vermicompost plus PGPR with the full dose at100%. it was more favorable in stimulating growth parameters, physical and chemical characteristics of berries, yield and nutritional status of Flame seedless grapevines as compared with the vines received 50% mineral fertilization as control. However, using 50% MN with the co-application of Vermicompost plus Potassium Humate in Gel formula (PHG) 100% had distinctive effect on total leaf chlorophyll content (SPAD). These organic compounds with biostimulants are safe alternatives for mineral fertilization to ensuring the sustainability in both conventional and organic viticulture.

Abbreviations:

VC: Vermicompost; (PHG): Potassium Humate Gel; (AMF): Arbuscular Mycorrhizal Fungi; (PGPR): Plant Growth Promoting Rhizobacterial; **(**MN): Mineral Fertilization.

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كفاءه استخدام الفيرمي كومبوست وبعض المنشطات الحيوية الآمنة في استعادة المحصول وجوده عنب صنف الفليم سيدليس في مزارع العنب المتدهورة

ياسمين عنتر محمود السيد* و ياسر محمد عويس الشويخ **

*المعمل المركزي للزراعة العضوية ، مركز البحوث الزراعية ، الجيزة ، مصر.

** قسم بحوث نباتات الزينة وتنسيق الحدائق ، معهد بحوث البساتين ، مركز البحوث الزراعية ، الجيزة ، مصر.

إن تحسين استدامة النظام البيئي لزراعة كروم العنب باستخدام الأسمدة العضوية مع العديد من المنشطات الحيوية الآمنة هو الهدف الرئيسي لهذا العمل وذلك للحصول على عائد وجودة عالية مع دخل مرتفع.

ولهذا، أجريت هذه التجربة في عامي 2020 و 2021 بعد موسم تمهيدي 2019 لتسليط الضوء على دور السماد العضوي فيرمى كومبوست(VC) المختلط بنوعين من المنشطات الحيوية وهما فطر الميكروهيزيا (AMF) بنسبه 150 و 300 جم / كرمة ، وثلاثة سلالات من البكتريا الجذرية المحفزة لنمو النبات (PGPR) بنسبة 50٪ و 100٪ ، أو السماد الطبيعي هيومات البوتاسيوم (PHG) بنسبة 50 و 100٪. وقد تم تطبيق جميع هذه المعاملات مضاف اليها نسبه 50 ٪ من التسميد المعدني الأساسي للمزرعه على كرمات عنب صنف فليم سيدليس عمر سبع سنوات المنزرعه في تربة رملية طمييه في مزرعة عنب خاصة متدهورة تقع على بعد 58 كيلومترًا طريق القاهرة – الإسكندرية الصحراوي، مصر. علاوة على ذلك ، تم رش جميع الكرمات المعامله مرتين بمستخلص VC على مرحلتين عمريتين ، عندما يبلغ طول العنقود حوالي 10–15 سم وعندما يصل قطر الحبه إلى حوالي 7–8 ملم وذلك لتعزيز النمو الخضري والحالة الغذائيه والمحصول وجودة الثمار.

أشارت النتائج التي تم الحصول عليها إلى أن (VC) بمشاركه المنشطات المختلفة سواء بنصف الجرعات 50٪ أو الكاملة منها 100٪ كان له دور إيجابي في تحسين جميع الخصائص مقارنه بالكنترول. تم تسجيل التفوق الواضح لهذه المعاملات بواسطه مزج الفيرمي كومبوست (VC) كأضافه للتربه مع (PGPR) بنسبه 100% والتي كانت أكثر ملائمه في تحفيز خصائص النمو ،الخصائص الفيزيائية والكيميائية للحبات ، المحصول والحالة الغذائيه. ومع ذلك فإن التطبيق المشترك للفيرمي كومبوست (VC) بالإضافة إلى (PHG) بنسبه 100٪ كان له تأثير مميز على محتوى الكلوروفيل الكلي للأوراق (SPAD). وهكذا، نجد ان هناك مجموعة واسعة من المنتجات العضوية والمنشطات الحيوية التي تعتبر اختيارًا قيمًا يجب استخدامها لتقليل التأثير الضار للأسمدة المخلقه ذات المدخلات الماليه العالية وذلك لتوفير الأمن الغذائي ومواءمة الزيادة السكانية.

الكلمات الداله: فيرمي كومبوست ، البكتريا الجذرية المحفزه لنمو النبات (PGPR) ، هيومات البوتاسيوم ، فطر الميكروهيزيا (AMF) ، جوده الفليم سيدليس.